margin, the other near the anal angle, which are hyaline. There being no other character by which this specimen can be distinguished from the type, it may be considered as a colour-variety.

Total length to tip of tegmen 4·5 mm., length of pronotal process 3 mm., length of tegmen 4 mm.

Two ♀ ♀ from Mabira, Uganda (*R. A. Dummer*).

This species is quite distinct from the two previously described.

Buckton's description of *H. nodosum* (Cameroons) is so bad that one must rely on his figure. This apparently differs from Distant's *H. pattersoni* (Gold Coast) only in the dark fuscous colour of the wings. It is therefore quite probable that Distant's species is merely a variety of *nodosum*, Buckt. The present species differs from *H. pattersoni* not only in the shape and puncturation of the pronotal process, but in the venation of the tegmen. In the former the first apical cell extends to the base of the second subapical cell, whereas in the latter it extends only halfway down the second subapical cell. The presence of a costal stigma seems to be characteristic of the genus.

Mr. Dummer writes that this is a very rare Homopteron which was secured by sweeping herbage for insects in the forest-paths of the Mabira, near Mulangi, 4000 feet, about 15 miles from the Ripon Falls to Nile commencement. He remarks on its similarity to some of the biting-ants of the district.

January 1923.

XLVI.—*An undescribed Fish from the Coal Measures of Lancashire.* By E. Leonard Gill.

The small fish here figured and described is one of the specimens (No. L 8585) in the remarkable collection of arthropod and other fossils gathered by the late Mr. W. A. Parker from clay-ironstone nodules in the Middle Coal Measures at Sparth, near Rochdale. With the rest of the Parker Collection it is preserved in the Manchester Museum, and I am indebted to the Keeper of the Museum, Dr. W. M. Tattersall*, for the opportunity of examining it.

Its remains occur in a nodule which has split almost along the median vertical plane of the fish, but the line of splitting runs slightly across this plane, so that the end of the snout is seen on one side only and the fragment of the tail on the other. As far as the body is concerned the two sides of the nodule are almost identical, so that for purposes of figuring I have thought it sufficient to represent the left side, which includes the snout, and to incorporate in the drawing the few additional details, chiefly of the tail-shaft and caudal fin, which appear only on the right. Unlike that of the body, the state of preservation of the head is very different on the two sides. On the left side—shown in the figure—the head has been considerably crushed in laterally. On the right its form is retained as a cavity in the nodule, and within this cavity are seen natural but rough and granular casts of the bones of the palate. The total length of the specimen is 3·7 cm.; the complete fish would be about 4 cm. long.

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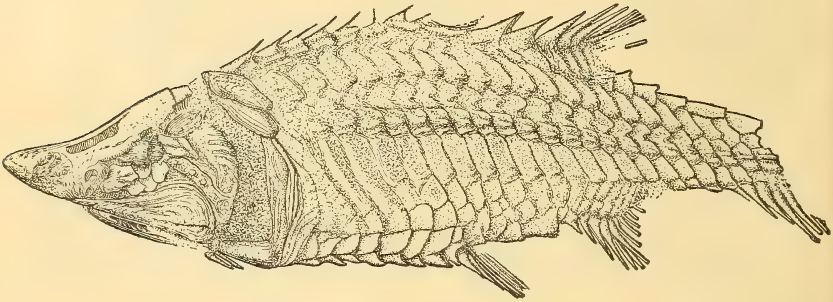
* Since appointed to the Chair of Zoology at Cardiff.



Phanerorhynchus armatus, × 3. Middle Coal Measures, Sparth, nr. Rochdale, Lancs. Manchester Museum, L 8585. Coll. W. A. Parker.

The specimen had not been critically studied, but palæontologists who had previously examined it were disposed to think it would turn out to be a "super-Palæoniscid," possibly allied to the Permian genus *Acentrophorus*, or, at any rate, a fish of a higher type than any hitherto known from the Carboniferous*. The prominent snout had not then been exposed and the general aspect of the fish was therefore quite different; and it was presumably the size of the scales, the strong dorsal and ventral ridge-scales and fulcra, and an appearance as of fin-supports equal in number to the dermal rays that suggested a relationship to the

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* A. Smith Woodward, Proc. Geol. Soc. 1915, p. lxxiii.

Semionotids. Further study of the specimen, however, has shown that such a view is untenable. The fish certainly exhibits a number of remarkable characters, but in essentials of structure it does not appear to have advanced beyond the stage of the contemporary Palæoniscids.

Both sides of the specimen seem, for the most part, to present natural moulds of the outer surface, and for that reason impressions taken from them are more intelligible than the fossil itself. The accompanying figure has been drawn chiefly from such impressions.

In general shape the fish is acutely fusiform, the snout being produced and pointed, the head rapidly deepening posteriorly, the back rising in a considerable arch behind the head, and the body narrowing behind the dorsal and anal fins to a comparatively slender tail-shaft. The line of the belly from the shoulder-girdle to the anal fin is nearly straight. The head is proportionately very large; the measurement from the point of the snout to the position that would be occupied by the back of the opercular plates is one-third of the total length to the base of the caudal fin; and the head was also very broad.

I have asked Prof. D. M. S. Watson, who has made a special study of the cranial structure of the Palæoniscidæ, to report on the head of this specimen, and I will here only remark on a few outstanding points that appear in the figure. The snout is produced in a roughly conical form in advance of the mouth to a distance equal to half the length of the mouth-opening; the mouth-opening itself is very long and straight as in the Palæoniscids, and the bones forming it appear also to be strictly of the Palæoniscid pattern. The maxilla, a narrow splint anteriorly, expands behind dorsally into a large rounded plate with concentric striæ; its extreme anterior point is slightly marked off from the rest and is possibly a premaxilla. The lower jaw is incompletely shown, but it is evidently narrow and practically straight. Part of its length is well preserved, and bears sharply-marked longitudinal striæ. It also shows a perfect cast of a short length of the mandibular sensory canal, with three of its lateral tubules running out obliquely to the surface of the jaw. The upper outline of the head from the snout backwards is first markedly concave, then gently convex. A conspicuous suture crossing the top of the head far back probably separates the frontal and parietal; the small bone behind it may be the whole of the parietal, and probably much of the skull-roof in front of it is formed by the frontals. The supratemporal is missing, unless it is to be recognised in the angular displaced bone lying on the upper part of the preoperculum. A group of small plates immediately above the maxilla presumably represent some of the circumorbitals. Overlying them anteriorly is a prominent, roughly triangular bone, which possibly also belongs to the circumorbital series in the position of a lachrymal. A large curved plate lying in the region of the orbit may be the displaced pterotic ("squamosal"); its true outline is largely concealed. Near the front of the snout is a conspicuous lateral pit, presumably for the nasal sac; its outer wall was either unossified or has broken away. Most of the opercular apparatus is missing on this side. Behind and above the back of the maxilla is a large bone, which I take to be the preoperculum; from a small ventral end it widens greatly upwards and is curved forwards. A strap-shaped anterior border with obscure tubercles is marked off from the hinder and upper portion, which is slightly tumid and transversely ridged. The only other elements of the opercular apparatus which appear are two of the smaller branchiostegal rays lying below the infraclavicle.

The shoulder-girdle is almost completely displayed on the left side. The uppermost element, the post-temporal, is proportionately larger even than in most Palæoniscids. Its hinder border is probably not quite complete. The bone is ornamented with concentric ridges parallel to the margins, the ridges nearest the median line being tuberculated. The supraclavicle (supracleithrum) is a similar bone to the post-temporal, and of about the same size. As seen in the specimen it is apparently displaced upwards and forwards; in life the shoulder-girdle would have the same wide arch as the back of the head, but in this nodule it has been flattened laterally like the body behind it, and the component bones have had to adjust themselves to the unnatural position. The cleithrum ("clavicle") is of unusual size. Its most conspicuous portion is a strong ridge running downwards and backwards from the supraclavicle, then bending slightly forwards and expanding into three adjacent ridges which may have reached nearly to the ventral margin. It is probably this ridged portion of the cleithrum which appeared at the surface behind the opercular plates. Both in front of it and behind it there are considerable expansions of the bone. The anterior of these expansions is deep-seated, and may have formed a sort of basin as in the sturgeon. The posterior expansion may in part represent one or more post-clavicular scales, but it is likely that most of it was overlaid by the regular scales of the body. Passing forward at right-angles to the ventral end of the cleithrum is a large "infra-clavicle" (true clavicle); it is cone-shaped, tapering slightly to a rounded anterior end, and by the flattening of the pectoral arch it has been pushed down a little below the natural ventral margin of the fish. The right side of the nodule shows a cast of the inner face of the cleithrum, with the hollow for the scapulo-coracoid cartilages close to the junction with the infraclavicle.

The squamation of the body is well-preserved only in a few regions; for the most part the true surface of the scales has been lost, and the impressions are granular and not too easy to decipher. The scales are rhomboidal, large, and in some regions exceptionally deep. Strongly developed ridge-scales occur along the mid-dorsal and mid-ventral borders; the ventral ridge-scales are paired as far back as to the pelvic fin, but the dorsal row is single, with each scale (to the dorsal fin at any rate, and probably to the tail) produced backwards into a long, very acuminate spine. About twenty-four transverse rows of scales are shown, and in the abdominal region there appear to be six scales in each row below the dorsal ridge-scales. Of these six the upper three cover two-thirds of the total depth of the body, and each of them bears a tubercle at or near its posterior ventral angle. There are thus three longitudinal lines of tubercles on the flanks of this fish. The upper and lower lines die out on the tail-shaft, but the middle line of tubercles, which throughout is much the most strongly developed, apparently extends to the caudal fin. These prominent middle tubercles are borne by the scales of the lateral line, which shows as a raised tube-like ridge on the last few scales, but is marked more anteriorly by deep notches. The scales next below the lateral line are, in the abdominal region, the deepest of all. Below them again, in each transverse row (but not behind the anal fin), come two scales of more ordinary form, and then the ventral ridge-scales. Between the pelvic and anal fins the paired ridge-scales are replaced by enlarged median scales, much like the anal scales commonly seen in the Semionotidæ.

Nothing is seen of the pectoral fin, but some portion of each of the others is preserved, though none is at all nearly complete. The dorsal fin is placed above the region where the body passes into the tail-shaft. In advance of it the dorsal ridge-scales are greatly enlarged and produced into very strong spines. By a rapid transition these pass into remarkably powerful fin-fulcra, below and behind which are seen parts of two or three dermal rays, unjointed in the length that is preserved. The fin was apparently based on a saddle-like lobe of the back; the rays must have been few, and must have sprung mainly from the posterior margin of the saddle, where the line of the back falls abruptly to the tail-shaft. The saddle is apparently covered by narrow scales in relation with the fulcra; they may even be the bases of the fulcra themselves. The anal fin, as a whole, is placed a little further back than the dorsal, and is based on a similar lobe of the body, similarly covered by narrow scales, which in this case seem to be a modified continuation of the two rows of more ordinary scales covering the lower flank in front of them. As with the dorsal fin, the front margin of the anal is protected by strong acutely-pointed fulcra. Of these, the first, immediately behind the anus, is short, and is followed by three more which show a graded increase in length; after which are seen the first two of the true fulcra based on the first dermal ray. Parts of six rays are preserved, and there is only room for one or two more. So far as they are seen, they are unjointed. Of the caudal fin nothing remains beyond a few of the fulcra bordering its ventral edge; but these are of quite extraordinary size and length, and suggest a well-developed fin. The specimen gives no hint as to the form and squamation of the caudal body-lobe. The only one of the paired fins of which anything is seen is the left pelvic, and of this only three or four fulcra of graded length are preserved, though there are rather ill-defined impressions of three dermal rays behind them. The pelvic fin was evidently narrow-based and probably rather long.

Of the general systematic position of this fish there can be little doubt. The patterns of the maxilla and of the lower jaw, together with the presence of well-developed infra-clavicles, associate it at once with the Palæoniscidæ. But it possesses characters which altogether exclude it from any known genus of the family. A rostrum slightly overhanging the front of the mouth is a common Palæoniscid character, but in no known member of the family is it developed into a long and massive snout such as is carried by this fish. The squamation also is entirely uncharacteristic of the family. The scales in the Palæoniscidæ are typically small; *Eurylepis* has deep scales on the flanks, and some other genera (e. g., *Canobius*, *Holurus*, and *Atherstonia)* have enlarged ridge-scales, but the combination of these characters with longitudinal rows of large tubercles and a line of dorsal spines is unknown in any described genus, nor is there any parallel in the family for the remarkable development of the fulcra into which the ridge-scales are transformed as they approach the median fins. A new genus must therefore be established for this strongly differentiated form, and in allusion to the prominent snout I propose for it the name *Phanerorhynchus.* The species represented by this specimen I p opose to name *Phanerorhynchus armatus.*

Note on the preceding Paper. By D. M. S. Watson.

At Mr. Gill's suggestion I have made an independent examination of the head of the unique specimen of *Phanerorhynchus.* The matrix which lay within the head, attached to the right side, showed impressions of certain bones of the palate; these had been so much broken by the original splitting of the nodule that is was quite impossible to gain any useful information from them: I therefore removed the whole mass, leaving exposed a beautiful impression of the whole right surface of the head. In the main this merely confirms Mr. Gill's account, but does bring out certain features more clearly.

The sutures between the parietals, frontals, and supratemporals are not clearly visible. Together these bones form a strongly arched roof to the skull, presenting a long free border to the operculum; this lateral border is thickened and rounded. The supratemporal appears to be perforated by a foramen for an otic branch of the 9th or 10th nerve. Behind the parietals lies a single pair of bones representing the tabular postparietal row. Behind these lies what is apparently a single very large scale, the first of the dorsal series.

The rostrum shows no trace of subdivision into separate elements. As Mr. Gill has described it, it forms a long massive projection, continuing the head forward in advance of the mouth. The olfactory pit lies entirely on its side, showing that the bone actually exposed is a cartilage-bone in the ethmoidal region. The whole appearance of this rostrum with its olfactory pit is precisely that of the cartilaginous rostrum of *Acipenser.* The structure here differs very markedly from that in an ordinary Palæoniscid.

On the side of the head is a large, nearly square antorbital, which articulates with the frontal above, the maxilla below, and apparently with a bone of the orbital margin behind.

Its anterior border has an articulation with the rostrum ventrally, and dorsally is cut out into two shallow notches which must have formed the posterior margin of an incompletely divided nostril.

Parts of four circumorbitals are shown, three of which are unfortunately not in their natural positions. The most dorsal and largest of these bones projects outward from the frontal, so as to carry the orbit away from the middle line. It is quite certain that the orbit was small.

The maxilla and the preoperculum are as Mr. Gill has described them, and there is in addition a small triangular bone lying between the latter element and the supratemporal, which appears to be homologous with the accessory preoperculum described by Traquair in *Cheirolepis*.

The bones of the operculum are well exposed on the right side; they are a large opercular ornamented with sparse longitudinal ridges, a small subopercular, and a long series of branchiostegals, the uppermost not much smaller than the subopercular. It is impossible to see if large lateral gulars and a median gular are present or not.

That Mr. Gill is correct in referring this remarkable fish to the Palæoniscidæ is obvious, but, as he has brought out, it represents a very aberrant type. The whole build of the fish, its squamation, the character of the tail-shaft, and especially the short-based pelvic fin and the small number and large size of the unjointed dermal rays in the fins are totally unlike those of any other Palæoniscid, and suggest most strongly a higher fish and especially a Semionotid.

The skull and shoulder-girdle, however, are conclusive evidence of Palæoniscid affinities, and I believe that we must see in *Phanerorhynchus* another case of the precocious acquirement of characters in a short-lived side-line, which, more slowly reached by a conservative stock, lead on to the establishment of a new order. In other words, this fish, although itself not ancestral to any later form, shows that the Palæoniscids had latent in them the potentiality of giving rise to the Lepidosteoid Ganoids, and hence to all higher bony fish.

It is obvious that *Phanerorhynchus* differs from all other fish so greatly as to deserve at least family distinction; but as to remove it from the family Palæoniscidæ would obscure its close relations to those fish, and as that family as at present constituted includes forms presenting a very great range in structure, I do not propose to establish a new group for its reception.